Iron-Absorption Band Analysis for the Discrimination of Iron-Rich Zones

Lawrence C. Rowan
U.S. Geological Survey
Washington, D.C. 20242

30 January 1973

Type II Progress Report for Period 1 July 1972 - 31 December 1972

Prepared for:

Goddard Space Flight Center
Greenbelt, Maryland 20771

/ Publication authorized by the Director, U.S. Geological Survey

STANDARD TITLE PAGE FOR TECHNICAL REPORTS	1. Report No.	2. Govt. Accession No.	3. Recipient's Catalog No.

4. Title and Subtitle

Iron-Absorption Band Analysis for the Discrimination of Iron-Rich Zones (SR 9648)

5. Report Date: 29 January 1973

6. Performing Organization Code

7. Author(s)

Lawrence C. Rowan (IN 345)

8. Performing Organization Rept. No.

9. Performing Organization Name and Address

U. S. Geological Survey
Washington, D. C. 20244

10. Project/Task/Work Unit No.

11. Contract/Grant No.

S-70243-AG

12. Sponsoring Agency Name and Address

G. Richard Stonesifer, Code 430
NASA Goddard Space Flight Center
Greenbelt, Maryland 20771

13. Type of Report & Period Covered

Type II Progress Report
1 July '72--31 Dec. 72

14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstracts

A lineament study of the Nevada test site is near completion. Two base maps (1:500,000) have been prepared, one of band 7 lineaments and the other of band 5 lineaments. In general, more lineaments and more faults are seen on band 7 than on band 5. About 45% of the lineaments appear to be faults and contacts, the others being predominantly streams, roads, railway tracks and mountain crests. About 25% of the lineaments are unidentified so far. Special attention is being given to unmapped extensions of faults, groups of unmapped lineaments, and known mineralized areas and alteration zones.

Earthquake epicenters recorded from 1869 to 1963 have been plotted on the two base maps. Preliminary examination as yet indicates no basic correlation with the lineaments.

Attempts are being made to subtract bands optically, using an I^2S viewer, an enlarger (continued)

17. Key Words and Document Analysis. (a). Descriptors

Mineralized zones
Major fault zones
Earthquake epicenters

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group

2

18. Distribution Statement

Unlimited

19. Security Class (This Report)	21. No. of Pages
UNCLASSIFIED	12
20. Security Class. (This Page)	22. Price
UNCLASSIFIED	

FORM NBS-867(1-70)

16. (continued)

and a data color viewer. Success has been limited so far due to technical difficulties, mainly vignetting and poor light sources, within the machines. Some vegetation and rock type differences, however, have been discerned.

Several critical problems have been encountered. Most important is the density range variation from band to band as a function of atmospheric attenuation in the different passes. Seventy-millimeter positives and negatives with constant density ranges, and therefore with variable gamma, are necessary to determine spectral differences with optical techniques. In addition, a calibrated gray scale related to the scene variance is needed on all film products.

Type II Progress Report

ERTS-A

a. Title: Iron-absorption band analysis for the discrimination of iron-rich zones

ERTS-A Proposal No.: SR 9648

b. GSFC ID no. of P.I.: 1345

c. The most critical problems encountered during the reporting period are, listed in order of decreasing importance:

1) The density ranges of the MSS images vary from band to band as a function of atmospheric attenuation, as well as scone reflectance. Seventy-millimeter positives and negatives with constant density ranges, and therefore with variable gamma, are necessary to determine the subtle spectral differences among soils and rocks. Although the bands can be differenced digitally, costs are far too high to permit analysis of sufficient quantities of data. Atmospheric-corrected images are therefore urgently needed.

2) A calibrated gray scale related to the scene radiance is needed on all film products. Radiometric fidelity is critical for every reproduction.

3) Seasonal variations in lighting have resulted in negatives that are too dense. This is problematic since most experiments need viable enlargements, both on film and on paper, to reach their objectives. GSFC should either produce the necessary reproductions or provide negatives which can be copied without special equipment.

4) Currently available viewing equipment has not been adequate for spectral analysis due to color temperature variations, vignetting, and low illuminations. See Section D.3 also.

5) Recently received positive prints (9 x 9) of the latest data are of good quality but are too dark. The ideal however would be to receive three sets of prints for each group of four bands ranging from light to medium to dark. This variation in the prints would allow maximum enhancement of subtle features and tones.

6) The light sources of the multiband viewers currently available are badly out of alignment. Vignetting effects are thereby enhanced, especially when filters are used.

7) Newton rings were initially a severe problem. Although the cause seems to have been alleviated, problematical images have not yet all been replaced.

d. Accomplishments during the reporting period are:

1) Lineaments seen on bands 5 and 7 have been transferred to two respective base maps (1:500,000, shaded relief) of the Nevada test site. Subsequent comparison with existing geologic maps aids in identifying many of the lineaments. Anomalous features and areas with unidentified lineaments are given close attention. Regional fault zones are especially watched for, including those paralleling the basic northwest trend of the Basin and Range terrain. The two lineament maps of Nevada are near completion.

2) Earthquake epicenters recorded from 1869 to 1963 have been plotted on the two base maps for analysis of correlation between the earthquakes and the lineaments.

3) Visual comparison of the MSS bands has been useful for discriminating geologic materials in some areas. In many cases, the differences are due to contrast in vegetation type or density. In a few cases, the rock and soil reflectance appears to be significantly lower with near infrared.

4) Preliminary attempts have been made to detect subtle spectral differences by subtracting bands optically. Thus far we have used a color additive viewer, an enlarger, and a color-coded density slicing system. For example, a negative and a positive of different bands of the same image were registered in the viewer. The fundamental problem of too weak a light source, however, was even further complicated by vignetting. Only a small central portion of the image was not affected by the vignetting. An attempt to overcome this problem involved superimposing the positive and negative before placing them in the viewer, this time as one unit. Even less light penetrated the image by this method, and the preliminary registration by eye was only partially successful.

Differences on superimposed images were enhanced substantially more on an enlarger, although the registration remained a problem. In addition, filters are unfortunately not included on the machine. The density slicing system, on the other hand, did not allow much light penetration. Vegetation differences seemed discernible, but further examination of data with this viewer is necessary.

Plans for the next reporting period include:

1) Completion of the Nevada base maps.

2) Preparation of similar base maps for the California test site.

3) Further examination of images on viewers, enlargers, data color viewer and use of densitometer.

4) Digital analysis of tapes currently on order for areas of special interest.

5) Continued literature research.

6) Field examination by air of some areas of the Nevada test site.

e. Significant results during the reporting period include:

1) More lineaments, including more faults can be seen on band 7 than band 5. Some interesting lineament patterns do occur on band 5, however. A few regional fault trends do seem to exist [in Eureka County and in Elko County] and are currently being examined. Extensions on the images of several mapped faults are also significant.

2) Preliminary plotting of earthquake epicenters in Nevada as yet indicates no basic correlation with lineaments.

3) Problems with vignetting on the viewer used, with strength of light source, and with registration on the enlarger and data color viewer, have prevented successful band differencing on these machines.

4) Valid and significant differences seem to exist among bands of the same scene. Vegetation differences are easily distinguishable, especially with the aid of a color composite, and rock type differences, notably basalt flows and granites and granodiorites, are also discernible. The reflectance differences in rock type probably are related to the iron content of the rock. The density range differences in each band, however, may be unfairly enhancing some of these differences. In addition, some sedimentary rocks such as dark shales and limestones, sometimes also vary in reflectance among the bands.

5) The geology of the Goldfield mining area can be seen on the images. It is hoped that the alteration zones within the dacite, which is well defined on the image, will be evident after the band subtraction process.

Very little of the geology of the Eureka mining district, on the other hand, can be discerned on the images.

f. None.

g. See item C-1, 2, and 5.

h. None.

i. Attached.

j. Jan. 15, 1973.

ERTS IMAGE DESCRIPTOR FORM

(See Instructions on Back)

NDPF USE ONLY
D
N
ID

DATE Feb. 5, 1973

PRINCIPAL INVESTIGATOR Lawrence C. Rowan

GSFC T 345

ORGANIZATION U.S. Geological Survey

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS		
	volcanics	playas	> 10% snow	mineralized regions	major fault zones	> 60% cloud
1019-18044				✓		
1019-18050		✓		✓		
1019-18053	✓			✓	✓	
1019-18055	✓					
1020-18103		✓		✓	✓	
1020-18110				✓		
1021-18160	✓					
1021-18163						
1033-17435						
1034-17491		✓			✓	
1034-17493		✓				
1035-17534						✓
1036-17585					✓	✓
1036-17592		✓		✓	✓	✓
1036-17594				✓		✓
1036-18003	✓					
1037-18044				✓		

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE PRODUCT ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

All imagery 70 mm MSS (4 bands)

MAIL TO

8

NDPF USER SERVICES
CODE 563
BLDG 23 ROOM E413
NASA GSFC
GREENBELT, MD. 20771
301-982-5406

ERTS IMAGE DESCRIPTOR FORM

(See Instructions on Back)

NDPF USE ONLY
D
N
ID

DATE Feb. 5, 1973

PRINCIPAL INVESTIGATOR Lawrence C. Rowan

GSFC T 345

ORGANIZATION U.S. Geological Survey

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS		
	volcanics	playas	> 10% snow	mineralized regions	major fault zones	> 60% cloud
1037-18050		✓		✓		
1037-18053	✓			✓	✓	
1037-18055	✓					
1038-18102						
1038-18105		✓		✓	✓	
1038-18111				✓		
1039-18161	✓					
1039-18163						
1053-17533	✓	✓				
1053-17540	✓			✓		
1053-17542	✓	✓				
1053-17545		✓				
1053-17551		✓				
1054-17585					✓	
1054-17592		✓		✓	✓	
1054-17594				✓		
1054-18001	✓	✓		✓		

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE PRODUCT ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

All imagery 70 mm MSS (4 bands)

MAIL TO

NDPF USER SERVICES
CODE 563
BLDG 23 ROOM E413
NASA GSFC
GREENBELT, MD. 20771
301-982-5406

ERTS IMAGE DESCRIPTOR FORM

(See Instructions on Back)

NDPF USE ONLY
D
N
ID

DATE Feb. 5, 1973

PRINCIPAL INVESTIGATOR Lawrence C. Rowan

GSFC T 345

ORGANIZATION U.S. Geological Survey

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS		
	volcanics	playas	> 10% snow	mineralized regions	major fault zones	> 60% cloud
1054-18003	✓					
1055-18044				✓		
1055-18050		✓		✓		
1055-18053	✓			✓	✓	
1055-18055	✓					
1052-17490		✓			✓	
1052-17493		✓				
1056-18102						
1056-18105		✓		✓	✓	
1056-18111				✓		
1057-18161	✓					
1057-18163						
1071-17533	✓	✓				
1071-17540	✓			✓		
1071-17542	✓	✓				
1071-17545		✓				
1071-17551		✓				
1070-17490		✓			✓	✓

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE PRODUCT ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

* All imagery 70 mm MSS (4 bands).

MAIL TO

NDPF USER SERVICES
CODE 563
BLDG 23 ROOM E413
NASA GSFC
GREENBELT, MD. 20771
301-982-5406

ERTS IMAGE DESCRIPTOR FORM

(See Instructions on Back)

NDPF USE ONLY
D
N
ID

DATE Feb. 5, 1973

PRINCIPAL INVESTIGATOR ~~Lawrence C. Rowan~~

GSFC T 345

ORGANIZATION U.S. Geological Survey

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS		
	volcanics	playas	> 10% snow	mineral-ized regions	major fault zones	> 60% cloud
1070-17493						
1072-17585					✓	
1072-17592		✓		✓	✓	
1072-17594				✓		
1072-18001	✓	✓		✓		
1072-18003	✓					✓
1074-18103						
1074-18105		✓		✓	✓	
1074-18112				✓		
1075-18161	✓					
1075-18164						
1090-17592					✓	✓
1090-17594		✓		✓	✓	✓
1090-18001			✓	✓		
1090-18003	✓	✓	✓	✓		
1090-18010	✓					
1091-18050				✓		
1091-18053		✓		✓		
1091-18055	✓		✓	✓	✓	

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE PRODUCT ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

* All imagery 70 mm MSS (4 bands).

MAIL TO

11

NDPF USER SERVICES
CODE 563
BLDG 23 ROOM E413
NASA GSFC
GREENBELT, MD. 20771
301-982-5406

ERTS IMAGE DESCRIPTOR FORM

(See Instructions on Back)

NDPF USE ONLY
D
N
ID

DATE Feb. 5, 1973

PRINCIPAL INVESTIGATOR Lawrence C. Rowan

GSFC T 345

ORGANIZATION U.S. Geological Survey

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS		
	volcanics	playas	> 10% snow	mineral-ized regions	major fault zones	> 60% cloud
1091-18062	✓		✓			
1092-18105						
1092-18111		✓		✓	✓	
1092-18114				✓		
1093-18164	✓					
1093-18170						
1105-17443						
1107-17541						✓
1107-17544						✓
1107-17550						✓
1106-17495		✓			✓	
1106-17501		✓				
1108-18002				✓		✓
1108-18005	✓	✓		✓		
1108-18011	✓					
1110-18113						✓
1111-18165	✓					✓
1123-17443						
1125-17542						✓
1125-17545	✓			✓		
1125-17551	✓	✓	✓			
1125-17554		✓				
1125-17560		✓				
1129-18165	✓		✓			
1129-18172			✓			

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE PRODUCT ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

* All imagery 70 mm MSS (4 bands).

MAIL TO

12

NDPF USER SERVICES
CODE 563
BLDG 23 ROOM E413
NASA GSFC
GREENBELT, MD. 20771
301-982-5406